Student Reactions to Online Homework Management Systems: A Look at Prior Research

John L. Haverty
St. Joseph's University
5600 City Ave.
Philadelphia, Pennsylvania, USA
jhaverty@sju.edu

Abstract

This article reviews existing research concerning the use of online homework management systems (OHMS), primarily in the accounting discipline, but also in other business and non-business disciplines. The review shows that students almost universally show a positive reaction to the use of these systems. This reaction generally occurs when study-specific instruments are used. When student reactions are measured using university-wide student evaluations however, reports of positive student reactions to the use of OHMS have been rare. Based on this review, recommendations are presented for developers of OHMS, faculty using an OHMS, and academic researchers studying the use of OHMS.

Introduction

Online homework management systems (OHMS) are becoming an accepted part of the modern educational landscape. These systems, developed by the major textbook publishers for a variety of disciplines, permit the instructor to assign homework that will be graded and recorded by the system. OHMS are evolving to include a great deal of instructor flexibility, including the ability to choose the homework, decide on the number of attempts permitted, tailor the amount and timing of feedback given to students. The appeal of these systems is obvious, including reduced grading time for the instructor, particularly in large classes or those classes offered online or in a hybrid format. Instructors in many disciplines have been testing these systems.

This article reviews prior introductions of OHMS primarily in the field of accounting, but also includes disciplines other than accounting in which instructors have attempted to measure student reactions to the use of OHMS. Recommendations for developers of OHMS and instructors introducing OHMS are generated, as well as some implications for future research on the use of OHMS.

Prior Research

Homework has always been assumed to be useful in increasing students' learning. For approximately 10 years, OHMS in various forms have been available, and instructor implementations have been increasing. Studies involving student reactions to OHMS in

disciplines other than accounting are examined first, followed by studies in the accounting discipline.

Studies of Online Homework Systems in Disciplines Other than Accounting

Exhibit A is a summary of studies of OHMS in disciplines other than accounting. The first column in Exhibit A shows the author(s) and year of the study and the second column shows the discipline of the study. The third column shows the results of measurements of student reactions, either positive or negative. The fourth column shows the instrument used in the study, either an instrument or method unique to the study or a university course evaluation instrument. The fifth column shows implementation lessons learned from the study.

Exhibit A shows 13 studies that tested student reactions to OHMS. Not surprisingly, these studies come from quantitative disciplines: chemistry—5 studies, mathematics—3 studies, economics—2 studies, business—2 studies, and physics—1 study. The two business disciplines were also quantitative: operations management and finance.

Exhibit A: Summary of online homework research in disciplines other than accounting

Authors, Year	**Discipline**	**Reported Student Reactions**	**Instrument**	**Implementation Lessons Learned**
Doorn, Janssen, O'Brien (2010)	Economics	Positive	Specific to the study	"Because students will make greater use of homework that helps them to understand the material and prepare for tests, instructors should select or make write questions that cover important concepts, are similar in format to questions on the exams, and provide an opportunity to practice for the exams." P. 17
Collins, Deck, McCricard (2008)	Intro-ductory Micro-economics	No effect	Student course evaluations	None noted
Heizer, Render, and Watson (2009)	Operations Manage-ment	Positive	Not disclosed	None noted
Hodge, Richardson and York (2009)	University algebra	Positive	Specific to the study	Perhaps a web based 'help sheet' would cut down on the amount of time students spend trying to 'figure out' what format the tool would accept. P. 9 Perhaps this could be remedied if the teaching assistants (instructors) were to point out the purpose of the web-based homework tool. P. 9 Complaints about the numbers changing each time the students entered the problem.
Fynewever (2008)	General Chemistry	Positive	Specific to the study	None noted.
Smolira (2008)	Introductor y corporate finance	Positive	Specific to the study	Rounding tolerances Students misreading the answer format
Donovan and Nakleh (2007)	General Chemistry	Positive	Specific to the study	None noted

Zerr (2007)	Calculus	Positive	Specific to the study	Use highest grade submitted Increase size of question banks—increase probability of getting different questions on each attempt
Arasasingham, Taagepera, Potter, Martorell, and Lonjers (2005)	General Chemistry	Positive	Specific to the study	Required answers to be submitted in specific ways Too much time spent in front of a computer screen. Perceived as too time-consuming
Hauk and Segalla (2005)	College algebra	Positive	Specific to the study	Entry format problems p. 240
Cole and Todd (2003)	General Chemistry	Positive	Specific to the study	None noted
Bonham, Beichner Deardorff (2001)	Intro-ductory Physics	Positive	Specific to the study	Computer gives no indication as to why a problem may be wrong. Multiple submissions encourage a trial and error strategy Emphasis on getting the final answer right without understanding the process.
Donovan and Nakleh (2001)	General Chemistry	Positive	Specific to the study	None noted

In 12 of the 13 studies, researchers reported positive student reactions to web-based homework. The only study that did not report positive student reactions (Collins et al. 2008) reported no effect on student evaluations as a result of the introduction of an OHMS. This was also the only study that used student course evaluations as a measure of student attitude toward an OHMS. All other studies used some specially constructed instrument unique to the study. It appears that the vast majority of the studies have shown that students have a positive attitude toward the use of web-based homework in the classroom. There were no overall negative reactions from students reported in any of the studies. Complaints or negative reactions did exist, but they were always in the minority.

The most frequent issue cited by the researchers in this review involved the necessity to enter an answer in a very specific format. Hodge et al. (2009) noted this problem in an algebra OHMS, and suggested a web-based help sheet to remind students about which format the program would accept. This problem is also noted by Smolira (2008) in a finance OHMS, Arasingham et al. (2005) in general chemistry, and Hauk and Segalla (2005) in college algebra. Format issues included OHMS's that would accept answers in specific format, including number of decimal places, percentages, negative numbers, use of blank spaces instead of the number zero, etc. This was the most pervasive issue cited by the researchers in this study. Other lessons learned included the need for care in selecting problems that included similar concepts and similar format to questions on the examinations, providing opportunities for students to practice for examinations (Doorn et al. 2010), the need to choose the highest score in a student's grade when multiple attempts are allowed for a particular assignment (Zerr 2007), and the issue of guessing (Bonham et al. 2001), when multiple attempts at a given assignment are allowed. These researchers felt that the existence of multiple attempts sometimes encouraged students to guess until obtaining a solution acceptable to the OMHS.

Studies of Online Homework Systems In Accounting

Accounting instructors have also used web based homework systems, and Exhibit B lists 13 studies that have attempted to measure student attitudes toward web-based homework systems and/or the effect on student achievement of web-based homework systems. The table is constructed similarly to Exhibit A. The first column in Exhibit B shows the author(s) and year of the study and the second column, since all these studies are from the accounting discipline, shows the course or courses tested in the respective study. The third column shows the results of measurements of student reactions, either positive or negative. The fourth column shows the instrument used in the study, either an instrument or method unique to the study or a university course evaluation instrument. The fifth column shows implementation lessons learned from the study.

Exhibit B: Summary of online homework research in accounting

Authors, Year	**Course**	**Reported student reactions**	**Instrument**	**Implementation Lessons Learned**
Khanlarian, Shough and Singh (2011)	Introductory accounting course	Positive	Specific to the study	"…benefits provided were somewhat outweighed by technological tribulations" p. 216 "…or when students figured out how to beat the system (guessing and collaboration)" p. 216 "There was a learning curve for faculty, but not just for operating the software. Faculty had to learn which problems to assign each week since we had to know when the software wanted a negative sign or capital letters for an answer. P. 216-7 "There were a few occasions where the answer was wrong and we had to contact the publisher." p. 217 "Don't use unlimited attempts. One student tried 205 times to get a correct answer." Drop-down menus encouraged guessing."
Phillips and Johnson (2011)	Financial Accounting	Not tested	None	"…an online OHS is geared to assessing outcomes, so it provides relatively less instructional support. Transaction performance increased when students used an intelligent tutoring system rather than an online homework system"
Chu and Man (2010)	Intermediate Accounting Cost Accounting	Positive	Specific to the study	"Guessing"
Gaffney, Ryan, and Wurst (2010)	Accounting (Financial)	No effect	Specific to the study Student course evaluations	None noted
Haverty (2010a)	Managerial Accounting	No effect	Student course evaluations	"Instructors must be careful to tie the online homework system into a final grade, or else students will most likely not use it" "much up front planning required" "last minute emails immediately before the problem was due" "did not support the use of Excel." "Students did not like a 7:00PM deadline"

				"students did not read the book"
Peng (2009)	Financial Accounting	Positive	Specific to the study	"instructors should not assume that student would benefit equally from an online homework system." P. 267
Collins, Deck, and McCricard (2008)	Introductory Financial Accounting	No effect	Student course evaluations	None noted
Dillard-Eggers, Wooten, Childs, Coker (2008)	Accounting principles	Positive	Specific to the study	Confusion with the answer format Students disliked unhelpful hints Technical problems Errors in the program Online homework problems too simple Inconsistencies between homework, class notes, and tests
Khanlarian and King (2008)	Two different accounting courses	Positive	Specific to the study	Rounding issues Issues concerning incorrect answers
Jones (2008)	Introduction to financial reporting	Positive	Specific to the study	Impact of technology (server outage) Five attempts considered ideal by 50% of the students Hints not that helpful Complaints about tests with no drop down menus Issues with long-end of chapter questions requiring long time in front of a screen
Marriott and Lau (2008)	Introductory Financial accounting	Positive	Specific to the study	None noted
Lippincott Matulich, and Squires (2006)	Introductory Financial Accounting Introductory Managerial Accounting Intermediate Accounting	Positive	Specific to the study	Frequent system errors Exacting format requirements for answer entry Data entry adds to homework burden Problems too long and complex Problems not representative of test questions Students "forced" to do more homework than anticipated Students volunteered that they cheat by working in groups or having others do their work outright by giving them their password. Students complained that they did not learn because they could guess at an answer until they got it right.
Potter and Johnston (2006)	Cost Management	Not tested.	None	None noted

Exhibit B lists 13 studies concerning the use of an OHMS in some accounting course. One of these studies (Collins et al. 2008) is also listed in Exhibit A since the study involved an economics class (listed in Exhibit A) as well as an accounting class (listed in Exhibit B). Not surprisingly, most of the studies involved either introductory financial accounting or introductory managerial accounting. Of the 13 studies listed in Exhibit A, 9 were clearly at the introductory level. In addition, one of the studies (Lippincott et al. 2006) included both introductory and upper level accounting courses. listed "two accounting courses" (Khanlarian and King 2008). Only two studies were clearly stated as involving upper level accounting courses.

Of the 13 studies listed in Exhibit B, two of these studies did not test student reactions to OHMS. Phillips and Johnson (2011) compared student performance using an OHMS as opposed to students using an online tutorial system, but did not measure student reactions. Potter and Johnston (2006) did not report student reactions to an OHMS.

Of the remaining eleven studies that did test student reactions to the use of OHMS, the vast majority of the researchers (8 of 11) reported positive student reactions, with only three studies reporting no effect. It is interesting that the three studies reporting no effect in student reactions to web-based homework systems all used regular student evaluations as measures of student attitudes. Again, it appears that the majority of students have positive reactions to web-based homework systems, but these positive attitudes do not seem to influence overall student evaluations in the subject courses. These results parallel the results of tests of student reactions to OHMS in other disciplines (Exhibit A).

Lessons learned from the accounting studies of OHMS are very similar to those noted in the studies from other disciplines than accounting. Format issues were noted by many researchers, including Khanlarian et al. (2011), Dillard-Eggers et al. (2008), Khanlarian et al. (2008), and Lippincott et al. (2006). Some format issues noted were the use of negative signs, capital letters, the number of decimal points required by an answer, expression of percentages, and the use of zeros or blank cells.

Problems related to the number of attempts permitted students and the prevalence of guessing by students were noted in some research, including Khanlarian et al. (2011), Chu and Man (2010), Jones (2008),and Lippincott et al. (2006). Interestingly, Khanlarian et al. (2011) reported one student who guessed 205 times before arriving at a correct answer. Obviously, the existence of a finite number of alternatives in drop-down menus combined with unlimited attempts encourages guessing, but too few attempts may result in over penalizing students for arithmetic or clerical mistakes.

Faculty issues involving the selection of problems to be included in the OHMS were often cited in lessons learned. Khanlarian et al. (2011) noted that faculty had to learn which problems to assign to avoid some of the format issues noted above. Dillard-Eggers et al. (2008) reported student complaints when the problems selected were too simple. Jones (2008) and Lippincott et al. (2006), on the other hand, reported student issues with long and involved problems and the sheer magnitude of the homework.

There were several issues raised concerning internal course consistency. The need to tie the OHMS into a course grade was noted by Haverty (2010b). Dillard-Eggers et al. (2008) noted complaints about inconsistencies among OHMS homework assignments, class notes and tests. In a similar vein, Jones (2008) reported student complaints that examinations did not have drop-down menus similar to the OHMS in the course.

Cheating issues were noted by some researchers, including unauthorized collaboration (Khanlarian et al. 2011) and password sharing (Lippincott et al. 2006).

There were some technical issues reported. Generalized "technological tribulations" (Khanlarian et al. 2011). Errors in the program involving incorrect answers (Khanlarian et al. 2011) (Dillard-

Eggers et al. 2008) (Khanlarian and King 2008), and server outage (Jones 2008) (Lippincott et al. 2006).

Conclusions and Recommendations

OHMS have been introduced into a wide variety of quantitative disciplines. In the accounting discipline, OHMS have been used largely in introductory accounting courses. Conclusions from this research review are presented, followed by some recommendations for developers of OHMS, faculty using OHMS, and researchers attempting to evaluate the use of OHMS.

Conclusions

Overall, students and faculty seem to accept these systems, and have learned to operate them over time. This general acceptance spans the accounting discipline as well as the other disciplines in the review. The acceptance does not flow into increased student evaluations, however. No research has yet reported an increase in student evaluation scores as a result of an introduction of an OHMS. Positive reactions have been near universally reported using survey instruments specific to the introduction of the OHMS. Apparently, the use of an OHMS is only a small component of the overall student evaluation of a course.

The most frequently noted complaint from the users of OHMS was the issue of answer format requirements. The OHMS often provided exacting format instructions, but students had some difficulty following them. Sometimes the same OHMS required different answer formats in different problems. This issue was noted in both accounting OHMS as well as in the other disciplines. In the accounting studies, problem choice was seen to be a related issue.

Complaints about system outages and incorrect answers were noted infrequently, but were difficult for faculty and students to deal with when they did occur. Apparently the developers of these systems are increasingly able to estimate and obtain the resources needed to run an OHMS with minimal downtime.

There was little concrete advice for faculty initiating use of an OHMS in their courses. The number of attempts issue was noted, but little more advice was given than to avoid unlimited attempts to discourage students from guessing at answers.

Recommendations for Developers of OHMS

Developers of OHMS need to consider measures to reduce format entry issues. Format entry issues are deceptively complex, and manifest themselves in many ways in accounting OHMS. They involve number of decimal places (rounding), expression of percentages and fractions, expression of negative numbers, expression of zero, the use of blank spaces in spreadsheets to represent the value of zero, etc. Format entry issues seem to be the most frequently reported problem in current OMHS. Issuing precise instructions to students on how to enter a particular number so as to satisfy the format recognized by an OMHS is a difficult task, and even if this task is done well, students have quite a difficult time dealing and following the instructions.

Accounting is a difficult subject for many, and when complex format entry instructions are layered on top of an already complex subject the result is student (and faculty) frustration.

Server outages have not been cited frequently as problems, but they are fatal for an instructor should they occur. Likewise, incorrect solutions or errors in the software have not been reported frequently, but they do cause massive problems for instructors should they occur. Developers undoubtedly feel great pressure to be the first to market an innovative OHMS, but quality control efforts need to be maintained. Server capacity and quality control of solutions should be a major element of a developer's promotional platform for OHMS to encourage faculty who may be reluctant to adopt OHMS because they fear these problems.

The following recommendations are offered to developers of OHMS:

1. Insure internal formatting consistency. Developers of OHMS should strive to have all numbers entered the same way throughout the complete OHMS, or should have the system recognize many possible different correct formats. For example, negative numbers should be entered with a minus sign throughout all problems in the OHMS, but the OHMS should also recognize parentheses.

2. Flag problems with special format instructions. This would enable instructors to choose problems that might avoid difficult formatting issues.

3. Make the instructions and format requirements student-friendly. All problems should be tested on students prior to publication. Student focus groups might be helpful in highlighting format issues.

4. Continue to insure adequate server capacity for the OHMS at its prime usage periods.

5. Maintain quality control efforts to insure correct solutions. This is a selling point for reluctant faculty.

6. Establish a means so faculty members can easily exchange best practices.

Recommendations for Faculty Introducing an OMHS

OHMS involve a bewildering set of choices or settings to use in tailoring the OHMS to an instructor's needs. These involve choice of problems, number of attempts to be permitted, due dates and times, special instructions. Research on OHMS to date has not shed a lot of light on particular choices, but has highlighted some important issues. Issues of answer formatting and student guessing seem to be the most frequently cited issues.

Faculty should choose problems to be included in the OHMS very carefully to avoid either formatting issues or problems unrelated to other assessments in the course. In addition, students have often complained that the OHMS problems were in different formats from the course examinations. Sometimes students complained that the examinations had different content than the work in the OHMS. This led them to question the "usefulness" of the OHMS as a means of improving their grade. Formatting issues can be minimized by making sure the instructor works

out every problem assigned to the students themselves as a student. Problems requiring overly exacting formats can be avoided. The degree of similarity to other course assessments is a more complex and unresolved issue. Individual faculty might attempt to minimize overlap between the OMHS and other assessments in order to challenge students. Some faculty, on the other hand, might try to make the other assessments very similar to those in the OHMS as a means of encouraging the students to take the OHMS more seriously.

The number of attempts seems to be a frequently cited issue in the research on OHMS. There appears to be no strong consensus on a specific number of permitted attempts, however. Most OHMS implementations have more than 1 attempt permitted, but there is much advice against an unlimited number of attempts to avoid student guessing.

The following recommendations are offered to faculty implementing an OHMS:

1. Solve every problem chosen in the OHMS as a student would. This provides the instructor with the means of avoiding problems with formatting issues, the most frequently cited issue in accounting implementations of OMHS.

2. Make sure your use of the OHMS fits into your overall assessment strategy, and make this strategy clear to the students. On one hand, it is possible to make other course assessments similar to the assignments in the OHMS to reward and encourage the use of the OHMS. On the other hand, it is possible to make the examinations very different from the OHMS in order to challenge the students and make sure they sharpen their general problem solving skills as a result of the course. The choice is up to the individual instructor, but should be clearly explained to the students.

3. Provide multiple attempts at the problem for students and count their highest grade, but do not use unlimited attempts. Guessing has been noted as a frequent student method of approaching an OHMS.

Recommendations for Researchers of OHMS

Prior research in a variety of disciplines shows that students and faculty are increasingly pleased with the use of OHMS in the classroom. Future research might want to provide guidance to instructors as to the nuances of these systems and provide guidance as to how to use OHMS to maximize the students' educational experience. OHMS have a wide variety of choices available to the instructor, including the selection of problems, the number of attempts permitted, the timing and nature of any feedback given to students, the percentage of the final grade allotted to OHMS work, etc. All instructors are seeking the best way to educate and motivate their students. OHMS provides a wide variety of choices, and faculty need direction as to the best choices available. Experimental research in this context is quite difficult, but anecdotal stories of implementation successes and failures need to be encouraged and collected. Faculty need a mechanism to share best practices to fully harness the power of this new and powerful instructional tool.

This review of prior research clearly shows students and faculty who have adopted OHMS have a favorable opinion of them. Measurement of student learning as a result of OHMS has been far more limited and far less conclusive.

The following recommendations are offered to researchers studying the implementation and effects of OHMS:

1. Additional research is needed to guide faculty through the myriad of choices available in OHMS, particularly involving the number of attempts and the nature and timing of student feedback.

2. Additional research needs to test the actual learning effect of these systems. A positive student attitude toward OHMS does not guarantee that they contribute positively to learning.

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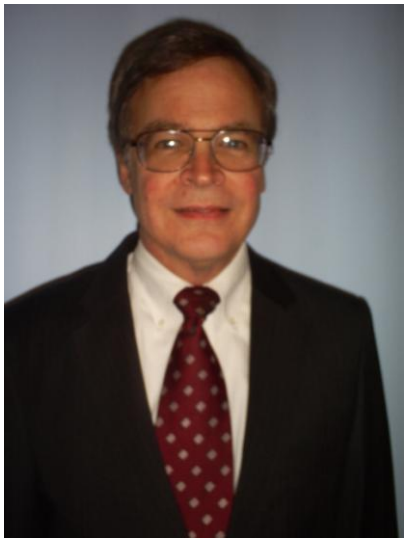

Biography

John L. Haverty is an Associate Professor of Accounting at the Haub School of Business at St. Joseph's University in Philadelphia. His research interests are in accounting education, managerial accounting and international accounting emphasizing China. Dr. Haverty's research has been published in *Accounting Instructors' Report, Academy of Business Disciplines Journal, Issues in Accounting Education, Journal of International Accounting, Auditing and Taxation, Advances in Managerial Accounting, Journal of Business Research, Industrial Marketing Management,* and *Journal of Services Marketing*.